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must be entirely changed. It must realize that steam and electricity have brought about a complete revolution, that the application of scientific principles and methods is becoming so universal elsewhere that all here who wish to succeed must adopt them.

So long as motors burn out, so long as subways are tied up by defective apparatus, so long as electric motors run too hot, so long as street cars can catch fire from so-called explosions of the current, so long as the traffic of a whole city can be stopped by a defective insulation or a ten cent motor brush, there will probably be the equivalent of research laboratories somewhere connected with the electrical industries, where attempts will be continually made to improve.

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*RECLAMATION OF THE ARID WEST*¹

THE benefits derived by applying science to industry and the still greater benefits that may be expected when all great problems are attacked in the scientific spirit and on the scientific methods are to a certain extent exemplified by the opportunities afforded and results now accomplished in the conservation of the natural resources of the nation.

The reclamation of the arid west is simply one of a number of items of national importance upon whose correct solution by true scientific methods rests largely, not merely the material prosperity of the nation, but, more than this, the perpetuation of free government, and of high standards of individual liberty.

The stability of a republic or democ-

¹Presented before the Congress of Technology at the fiftieth anniversary of the granting of the charter of the Massachusetts Institute of Technology.

racy, whichever we may term it, rests not upon its wealth, but upon the character of the individual citizen and voter. The greatest commonwealths are not necessarily those having the greatest natural resources, but rather those in which the human units are strong. The strength of the unit, the family or the voter, is not derived from material wealth, but from ability to act and think independently and to exercise that intelligent self-interest which binds him to the great mass of his fellow men. If, for example, he is working in a factory or on a railroad line, he is, of course, interested in keeping his job. Beyond this, he has little concern with the condition of municipal, state or federal affairs. These are entirely too remote to touch him, and if he lives in a tenement, he has no concern beyond paying his rent and getting the most he can for it.

But take this man, indifferent to forms or details of government, and put him upon a 40-acre farm. Assuming that he has reasonable industry and intelligence, his whole view-point of life changes. He is transformed from being more or less of a nomad, shifting from flat to flat, or from town to town, and indifferent to the general welfare. He now becomes a land-owning citizen and voter, interested in every public movement for better roads, better schools, better local government and everything which leads up to the stability of the institutions of the state as upon these rest the value and comfort of his home.

This thought has been most pithily embodied in a statement attributed to Edward Everett Hale where he asks "Whoever heard of a man shouldering his musket to fight for his boarding house?"

The problem of the reclamation of the arid west is being attacked primarily for the purpose, not of making men rich, but

of strengthening the foundations of the state. It is an attempt being made by the federal government almost at the eleventh hour of its opportunities to utilize the waste resources still remaining at its command, and to employ these in such a way as to strengthen local communities and states, and to create in the more remote parts of the country many prosperous communities composed of independent, landowning citizens, each family being resident upon a farm sufficient for its support, and cultivating the soil intensively, under favorable conditions of sunlight and of water supply, such as to produce the largest crop yield per acre, and to bring about the largest individual success.

The people thus placed upon the farms are not merely producers. They not only raise enough to support themselves, and to sell to their neighbors, but indirectly they stimulate all industries. They are large consumers, as well as producers, and it may be said that for every family placed upon an irrigated farm on the desert, there arises the possibility of another family engaged in transportation or in manufacturing in the east or middle west. All parts of the country are thus linked together. The success of the irrigator in the west means larger cotton production in the south, more boots made in Massachusetts, more freight and passenger cars hauled across the continent.

The success already attained in applying scientific methods to this great problem of conservation of the waste resources of the country may be attributable in part at least to the Institute of Technology, and to the instruction there given. The Reclamation Service, organized under the act of June 17, 1902, includes among its principal men and guiding hands many graduates or students of the Institute of Technology.

The training at the institute has been peculiarly effective in building up in the minds of its students a grasp of the larger conditions, and a proper confidence in ability to handle these. The first thing in any undertaking, such as that of studying the resources of a nation, is to gain a comprehensive view of these and to set on foot investigations and measurements in detail such that the conclusions will have direct value and application to the larger problems involved.

With a comprehensive and reasonably accurate review of the conditions to be met, it is then possible to bring to the solution of the problem the principles and methods of engineering and to put into play the constructive ideas which are inseparable from a technologic education.

The great difference between the methods pursued at the institute and those at many of the older institutions appears to lie in this constructive idea in the inculcation of the conception that the great work of life is to initiate and to build on correct lines rather than to simply know what others have done, and to imitate those.

The constructive faculty, the ability to imagine or to picture desirable results, and to turn these into accomplishment by scientific methods is the foundation for success in these larger lines of work.

In the matter under consideration congress in 1888 authorized an investigation of the extent to which the arid lands might be reclaimed. This problem is enormous and its correct solution is fundamental to the future growth and development of the nation, because of the fact that one third of its area is arid. In that third are potentially some of the most valuable lands in the world.

The problem is to obtain water for these lands. This in turn rests upon questions of economics and engineering, in storage

of flood or other waste waters, and in the adjustment of a form of agriculture suited to these conditions. The results already attained show that the lands are not only capable of supporting a large population, but under government auspices many thousands of families have been settled in prosperous homes and a highly desirable class of citizenship has been created in a most sparsely populated part of the country.

As a natural outgrowth of the investigation begun in 1888, the so-called Reclamation Act of June 17, 1902, was passed, setting aside the proceeds from the disposal of public lands for the construction of works for the reclamation by irrigation of the arid and semi-arid lands. It has been held that congress has absolute control over the public lands and of the funds arising from their disposal, and while it might be questionable as to whether the United States could levy taxes, and thus raise money for reclamation, it has been considered that congress could properly create a trust fund derived from the source named. This fund has amounted to over \$60,000,000, and is being added to at the rate of six or seven millions a year. It has been invested in the construction of reservoirs, canals and distributing systems, and already twenty-seven projects have been initiated or completed, works having been undertaken in each of the western states and territories.

Over a million acres have been reclaimed, and 14,000 families are receiving water from works built or controlled by the government, under the terms of this act. Reservoirs have been built having a capacity of nearly 5,000,000 acre-feet, that is to say, the water would cover 5,000,000 acres to a depth of one foot. Canals of large size, carrying over 800 cubic feet per second, have been built for a total length

of 300 miles, and somewhat smaller canals constructed with a length of a thousand miles including the ditches. There are over 5,000 miles of water courses, also nearly 70 tunnels with a total length of about 20 miles. The smaller structures number over 20,000 including bridges, culverts, headgates, siphons, etc. Nearly 60,000,000 cubic yards of earth have been excavated and 10,000,000 of loose and solid rock.

The principal results, however, are shown in the crop production and although the works are hardly built to a point further than to try out productions it appears that the value of the crops raised in 1910 was nearly \$20,000,000. Land values have advanced from practically nothing to one hundred million dollars. These values will continue to increase as the works near completion.

The object, however, as before stated, is not to make men rich, but to make homes for citizens who will preserve the institutions of the country, and to do this without imposing a burden upon the taxpayers. It has been shown how this is being accomplished by the use of the reclamation fund, which is revolving and growing larger and larger, that is to say, as the money comes back from the works completed, it is used over again and is being increased by additions from the disposal of other public lands. Under wise administration the funds should increase and produce larger and larger results in the conservation of the waste waters and the utilization of these in those parts of the United States where rain is infrequent and where the brilliant sunshine can be depended upon nearly every day in the year. It is really the sunlight which is capitalized and made valuable.

The question is frequently asked, why should not the government reclaim the

worthless lands in the east? The answer lies largely in the fact that no other part of the country than the arid west has such wonderful opportunities for crop production, as it does not have the continuous daily sunshine upon which plant life depends. The advantages of the development in the arid region also are greater from the political standpoint, as population is better distributed and is brought nearer to important sources of mineral wealth, enabling development of industries in otherwise remote and inaccessible localities.

All of these results are successful in proportion as they have been brought about by scientific methods, and by following the principles inculcated at the schools of which the Institute of Technology is chief.

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THE ST. LOUIS UNIVERSITY EXPEDITION TO COLORADO

IN a recent number of the *Fleur-de Lis*, one of the publications of the St. Louis University, there appears an article on a geological expedition to Colorado, organized last summer by that university. Its purpose was to afford an opportunity of geologic field-work to those teachers who were called upon to teach geology as an accessory subject, in addition to other regular work. Accordingly, those who availed themselves of the opportunity were chiefly professors of physics and chemistry. They were: Professor John P. Coony, head of the department of chemistry, St. Louis University Medical School; James I. Shannon and Charles Cloud, professor and associate professor, respectively, of physics, and Theodore Schulte, professor of chemistry, St. Louis University; Joseph Wilczewski and William Agnew, of the department of physics, St. Ignatius College, Chicago; A. M. Schwitalla, professor of chemistry, St. Xavier College, Cincinnati; Vincent Jenneman, pro-

fessor of physics, Sacred Heart College, Prairie du Chien, Wis.; Hugo Sloctemeyer, curator of the Mineralogical Museum, St. John's University, Toledo, O.

Colorado, and especially the foot-hill region, was chosen for its variety of geological formations within a comparatively small area. Ten days were spent near Cañon City chiefly to study the occurrence and formation of igneous and metamorphic rock in the Royal Gorge of the Arkansas River. Camp was then moved to Garden Park, ten miles north, where during four days attention was principally directed to the foot-hill topography and the strata profiles in Oil Creek Cañon. The famous dinosaur beds of the region were also examined as carefully as was possible under the circumstances. Finally, more than two weeks were spent in the Ute Pass near Manitou, where, besides special problems investigated by the individual members of the party, some coordinated work was done on the formations of the Manitou embayment, and the Archæan-Cambrian contact in this region. The pedagogical character of the work was continually kept in mind, and the results were such as to warrant a repetition of the experiment.

A. M. SCHWITALLA

RESOLUTIONS ON THE DEATH OF PROFESSOR CHARLES OTIS WHITMAN

AT the Ithaca meeting of the Eastern Branch of the American Society of Zoologists in December, 1910, it was voted that "the president appoint a committee to prepare a resolution on the death of Professor Whitman, the resolution to be published in the minutes of the society, and transmitted to the family of Professor Whitman." In accordance with this vote Professor S. F. Clarke and Professor F. R. Lillie were appointed on this committee. They have prepared the following resolutions which have been incorporated in the permanent records of the society:

The Eastern Branch of the American Society of Zoologists records with profound regret the death of Professor Charles Otis Whitman on December 6, 1910. Professor Whitman was one of the founders of this society; he was chairman